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Percutaneous Transluminal Angioplasty of Proximal Subclavian Artery Stenosis After Left Internal Mammary to Left Anterior Descending Artery Bypass Surgery

SHMUEL SHAPIRA, MD,* SIMON D. BRAUN, MD,† BRAHMAJI PURAM, MD,
GAUTAM PATEL, MD, HAROLD ROTMAN, MD

Durham and Asheville, North Carolina

A patient is described who underwent percutaneous transluminal angioplasty, through a brachial approach, of a high grade stenosis at the proximal portion of the left subclavian artery 1.5 years after coronary artery bypass grafting including left internal mammary to left anterior descending artery anastomosis. Symptoms of class IV angina, vertebrobasilar insufficiency and occupational arm claudication that developed after bypass surgery were promptly relieved after balloon dilation.

Percutaneous transluminal angioplasty of the subclavian artery can be performed safely and provides an alternative to carotid-subclavian or axillary-axillary bypass surgery for treatment of internal mammary artery graft malfunction.

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The left internal mammary artery to left anterior descending coronary artery graft has become the preferred coronary artery bypass conduit (1). Myocardial ischemia rarely occurs after internal mammary artery grafting and is usually associated with stenosis at the site of anastomosis or progressive disease of the native distal left anterior descending artery (2).

Hemodynamically significant stenosis of the left subclavian artery proximal to the origin of the internal mammary artery has been described in approximately 0.5% to 1.1% of patients undergoing coronary artery bypass grafting. To date, carotid-subclavian bypass grafting has been the preferred treatment for internal mammary graft malfunction caused by disease of the subclavian inflow tract (3). In this report, we describe a patient with extensive bilateral carotid artery disease and left internal mammary to left anterior descending artery graft malfunction who underwent successful percutaneous transluminal angioplasty of a proximal left subclavian artery stenosis. The very good immediate results have persisted during 12 months of follow-up.

Past history. A 49-year old man with a recent non-Q wave myocardial infarction demonstrated accelerated angina, left arm claudication and intermittent dizziness associated with use of the left arm. Three years before the current infarction, he had sustained a right hemispheric cerebrovascular accident with left-sided weakness. He had a residual left hemiparesis and occasionally suffered from vertigo, staggering gait, impaired vision and nausea. Thoracic aortography revealed occlusion of the right common carotid artery at its origin. The left subclavian artery was not well visualized at that time. Antihypertensive drug therapy was begun and the patient resumed work as a carpenter.

Two years previously, he had had an inferior wall myocardial infarction. Cardiac catheterization revealed proximal occlusion of the right coronary artery and 90% stenosis of the proximal left anterior descending artery. The distal right coronary artery was well visualized by retrograde collateral flow. He had an ejection fraction of 57% and regional inferobasal hypokinesia. He underwent coronary bypass surgery with left internal mammary to left anterior descending artery grafting and reverse saphenous vein grafts to the first diagonal and posterior descending coronary arteries.

Present history and findings. Soon after the bypass operation, the patient reported recurrent dizziness and left arm claudication associated with chest discomfort. This was relieved without medication or sometimes with one sublingual nitroglycerin tablet when he sat with crossed legs or leaned forward with his arms in his lap. At the time of his non-Q wave myocardial infarction, physical examination revealed a markedly diminished left radial pulse. Blood pressure was 90/60 mm Hg in the left arm and 140/80 mm Hg in the right arm. Neurologic examination revealed a left hemiparesis with the left arm disproportionately weaker than the left leg. He had signs and symptoms of vertebrobasilar insufficiency and an associated right to left subclavian steal. Doppler ultrasound confirmed retrograde flow in the left vertebral artery and demonstrated a high grade, hemodynamically significant stenosis at the bifurcation of the left common carotid artery.

Repeat cardiac catheterization demonstrated occlusion

From the Department of Internal Medicine and Cardiology Section, Veterans Affairs Hospital, Asheville, North Carolina and Duke University Medical Center, Durham, North Carolina and †Asheville Radiology, Asheville.

*Current address and address for reprints: Shmuel Shapira, MD, Humana Hospital New Orleans, 6040 Bullard Avenue, Suite 200, New Orleans, Louisiana 70128.

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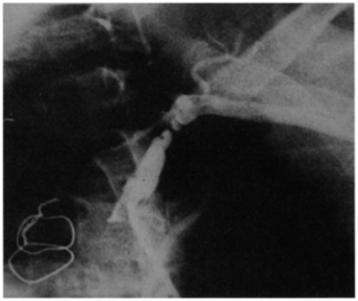

Figure 1. High grade stenosis of the proximal left subclavian artery demonstrated with cineangiography at the time of cardiac catheterization.

of both saphenous vein grafts. The native right coronary artery remained occluded with collateral reconstitution from the left anterior descending and left circumflex artery circulations. The 90% stenosis of the proximal left anterior descending artery was still present. A left ventriculogram demonstrated an ejection fraction of 28% with global hypokinesia. Attempts to cannulate the left internal mammary artery failed and a selective injection into the left subclavian artery demonstrated a high grade stenosis proximal to the origins of the left vertebral and internal mammary arteries, with diminished anterograde flow distally (Fig. 1).

Repeat thoracic aortography again demonstrated occlusion of the right carotid artery at its origin. An 80% to 90% stenosis of the left carotid bulb and proximal left internal carotid artery was confirmed as was a high grade stenosis of the proximal left subclavian artery (Fig. 2). There was distal reconstitution of the left subclavian artery through a right to left subclavian steal.

Left subclavian angioplasty. Carotid-subclavian artery bypass grafting was ruled out because of the patient's bilateral carotid artery disease, and it was decided to perform percutaneous transluminal angioplasty of the proximal left subclavian lesion. Because this lesion could not be crossed in an anterograde fashion despite many attempts, it was approached in retrograde fashion from the left brachial artery. As there was no palpable left brachial pulse, the vessel was visualized with digital subtraction angiography through a right subclavian injection and punctured percutaneously under fluoroscopic control. The lesion was then successfully traversed in retrograde fashion with a Medi-tech Glidewire and dilated with a Medi-tech Ultrathin balloon catheter (1.67 mm shaft, 8 mm diameter, 3 cm length). Postangioplasty arteriography demonstrated marked radiographic improvement in the caliber of the subclavian artery and the left internal mammary artery. Anterograde flow in the left vertebral artery was restored (Fig. 3) as were the left brachial and radial pulses. The patient underwent 24 h of systemic heparinization.

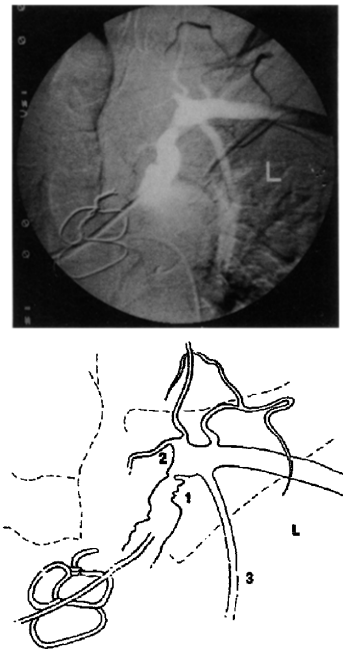

Figure 2. Selective digital subtraction angiogram (**top**) and diagram (**bottom**) of the left subclavian artery before percutaneous transluminal angioplasty. Note the obstruction in the subclavian artery (1), the absence of flow in the vertebral artery (2) and a relatively diminutive left internal mammary artery (3). L = left side.

Follow-up. Before hospital discharge the patient had strong left brachial and radial pulses and reported that his left hand was much stronger. Doppler ultrasound confirmed restoration of anterograde flow in the left vertebral artery. Twelve months after the procedure, the patient remained free of angina, dizziness or left arm claudication.

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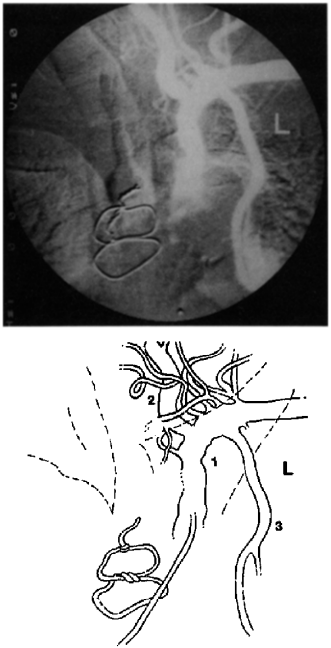

Figure 3. Selective digital subtraction angiogram (top) and diagram (bottom) of the left subclavian artery after percutaneous transluminal angioplasty. The subclavian artery is now normal in caliber (1). There is restoration of anterograde flow in the vertebral artery (2) and there is markedly improved flow in the left internal mammary artery (3). L. = left side.

Discussion

Incidence of subclavian artery stenosis. The use of left internal mammary to left anterior descending artery grafting has gained widespread support. Long-term patency rates have been translated into increased survival and reduced postoperative recurrence of angina (1). Although the internal mammary artery is known to be relatively immune to atherosclerotic disease, its parent vessel, the subclavian artery, is not. The reported angiographic incidence of 0.5 to 1.1% of atherosclerosis in the subclavian artery may be an underestimate because of the small number of patients who undergo diagnostic thoracic aortography before coronary bypass surgery. In view of the routine use of left internal mammary grafting, it is possible that the incidence of graft malfunction secondary to proximal subclavian disease may increase. Vertebrobasilar insufficiency and subclavian steal syndrome are well known complications of proximal subclavian stenosis. One patient with left internal mammary to left anterior descending graft malfunction and vertebrobasilar insufficiency has been reported (4).

Indications for subclavian artery angioplasty. The treatment of symptomatic subclavian stenosis has been traditionally surgical, utilizing either carotid-subclavian or axillary-axillary bypass grafting depending on local surgical preference and the underlying anatomic conditions. Percutaneous transluminal angioplasty, however, offers certain advantages and has been gaining popularity (5–7).

The patient presented here was not a candidate for carotid-subclavian bypass grafting because of severe bilateral carotid disease. Axillary-axillary grafting was also considered to be not advisable in this patient. A single case has been reported (8) of left subclavian artery angioplasty for internal mammary graft malfunction in a patient whose only symptom was angina.

The extended long-term results of percutaneous transluminal angioplasty of the brachiocephalic vessels have not been well studied. Nonetheless, the complication rate in patients undergoing angioplasty for vertebrobasilar insufficiency appears low and one would not anticipate any increased complications in patients undergoing subclavian angioplasty for secondary internal mammary graft malfunction. Bilateral blood pressure measurements and Doppler ultrasound are recommended in the evaluation of patients with angina or vertebrobasilar insufficiency, or both, after internal mammary artery grafting. In more difficult cases, thoracic aortography—in particular, digital subtraction thoracic aortography—is probably indicated.

Clinical implications. If stenosis of the proximal subclavian artery, with further investigation, appears to be more frequent than heretofore suspected, it may be justified to visualize the subclavian artery in all prebypass catheterizations. Both Judkins and Amplatz right coronary artery catheters are well suited to subclavian angiography and one would not expect this relatively simple procedure to significantly affect the morbidity or mortality of standard cardiac catheterizations.

Addendum

The patient remained asymptomatic for 12 months after the procedure. Subsequently he moved to another state and was lost to further follow-up.

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